Review T3 Part 2B

1) What is the fundamental frequency of the wave produced by the 1.25 meter long wire?

$$\ell = \frac{1}{2}\lambda$$

$$1.25m = \frac{1}{2}\lambda$$

$$\lambda = \boxed{2.5m}$$

2) The tension on the wire shown above is 46.0N. The wire has a linear density of 0.005kg per meter. What is the frequency of the sound produced by the wire?

$$v = \sqrt{\frac{tension}{linear\ density}}$$

$$f\lambda = v$$

$$f\lambda = \sqrt{\frac{tension}{linear\ density}}$$

$$f(2.5) = \sqrt{\frac{46N}{0.005kg/m}}$$

f = $\boxed{38.4Hz}$

3) What is the fundamental frequency of the 1.32 meter long pipe which is closed at one end?

$$\ell = \frac{1}{4}\lambda$$

$$4\ell = \lambda, so\lambda = 5.28m$$

$$v = f\lambda$$

$$f = \frac{v}{\lambda} = \frac{340m/s}{5.28m}$$

f = $\boxed{64.4Hz}$

4) If the tube above produces the fifth harmonic, what is the wavelength of the waves?

$$\ell = \frac{5}{4}\lambda$$

$$\frac{4}{5}\ell = \lambda$$

$$\frac{4}{5}(1.32m) = \lambda$$

λ = $\boxed{1.06m}$

5) What is the frequency of the fifth harmonic?

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

$$f = \frac{340}{1.06m}$$

f = $\boxed{322Hz}$

6) What is the fundamental frequency of the 1.32 meter long pipe open at both ends?

$$\ell = \frac{1}{2}\lambda$$

$$2\ell = \lambda, so\lambda = 2.64m$$

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

$$f = \frac{340m/s}{2.64m}$$

f = $\boxed{129Hz}$

7) What is the frequency of the third OVERTONE the open tube above will produce?

$$\ell = \frac{4}{2}\lambda$$

$$\frac{1}{2}(\ell) = \lambda, so\lambda = 0.66m.$$

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

$$f = \frac{340m/s}{0.66m}$$

f = $\boxed{515Hz}$

8) What beat frequency would be produced if the two pipes (playing their fundamental frequencies) are played at the same time?

$$f_b = |f_1 - f_2|$$

$$f_b = |64.4Hz - 129Hz|$$

f_b = $\boxed{65Hz}$

9) A radio station transmits waves that have a wavelength of 2.956 meters. What would you have to tune your car radio to listen to this station?

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

$$f = \frac{3 \times 10^8 m/s}{2.956m}$$

f = $\boxed{101Hz}$

10) What is the range of human hearing?

The range is approximately 20Hz to 20kHz.

11) When a 256Hz tuning fork is struck simultaneously with an unknown fork 5 beats are heard in 1 second. A small piece of gum is added to the unknown fork and the experiment is repeated but now 3 beats are heard each second. What is the natural frequency of the unknown fork?

$$f_b = |f_1 - f_2|$$

$$5Hz = |256Hz - f_2|$$

The second fork either has a frequency of 261Hz or 251Hz. Adding gum decreases the frequency of the tuning fork, making it closer in value to 256Hz, so it must be greater than 256Hz. Therefore, the unkown fork has a frequency of 261Hz.